Obesity in relation to socioeconomic status
A population study of women in Göteborg, Sweden

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SUMMARY   In a population sample of 1462 middle-aged women socioeconomic data were studied in relation to obesity, assessed by a body weight index. Education, annual income, and social class were negatively correlated with weight index (WI). Husband's social class was a stronger determinant of obesity in the woman than her own class. Age of husband and number of children were significantly correlated with WI. There was also a weak correlation between being single and WI. Sick leave was not correlated to WI. Pension was correlated to WI when adjusted for age, but not when allowance was also made for social class. Age, husband's social class, education, husband's income, and number of children were independent predictors of WI among the married women. In the single women, age and own income were independent predictors of WI but not number of children, education, or own social class.

Obesity is a common nutritional disorder in affluent societies.[1] Both genetic and environmental factors are important in the development of the disorder,[2] but only the environmental factors are subject to change. Socioeconomic status is a measure of familial environment. It may therefore be used to determine the environmental advantages or disadvantages associated with obesity and to detect population segments in which preventive measures would be most useful.

An inverse relationship has previously been found between socioeconomic status and obesity in both men and women.[3-6] However, recent studies have shown changing patterns in the prevalence rates of obesity with socioeconomic status.[7] For women the prevalence rates have decreased with increasing socioeconomic status but the opposite has been found for men.[7-10]

Most previous studies of this subject have used selected groups, not random samples of a well-defined population. Nor have they included the whole ranges of obesity and socioeconomic status.

In 1968–9 we studied a population sample of middle-aged women in Göteborg, Sweden.[11] An assessment was made of the nutritional status of the participants, and demographic data were also obtained.

The purpose of the present paper is to investigate the relationships between obesity and various socioeconomic factors.

Material and methods

A population sample of middle-aged women in five age strata (38, 46, 50, 54 and 60) was studied in Göteborg, Sweden, in 1968–9.[11] Altogether 1462 women participated, corresponding to 90·1% of those initially sampled. Women born on dates which were preselected multiples of six (6, 12, etc.) were called for study. The sample was obtained from the Revenue Office Register. Those born at the beginning of the year were called first. The survey was performed for the most part during a 12-month period.

Information about the marital status of the participants was obtained from the Revenue Office Register. Information about education, number of children, age of husband, housing standard, duration of sick leave during the year preceding the examination, and social class was obtained by questionnaire. The subjects were divided into five social classes according to Carlsson.[12] Women occupied with domestic work but no work outside the home and those on a pension were divided into separate classes. The classification of all the participants was made by the same person. The total income was recorded. Pension was regarded as income.

The women were asked to attend the examination after an overnight fast but were allowed water in the morning. They wore only briefs when they were

weighed. Body weight was recorded to the nearest 0·1 kg. Body height was measured without shoes and recorded to the nearest 0·1 cm. A body weight index (WI) was then calculated, according to Broca, as:

$$\left[\frac{\text{Body weight (kg)}}{\text{Body height (cm)} - 100} \right] \times 100$$

Statistical methods

Pitman's permutation test was used for analysis of the factor versus WI with other variables taken into account. In the multivariate analyses social class was taken to be that of the head of household. In these analyses subgroups of women were formed for the confounding variables and the association between the factor and WI was tested in each subgroup. The results from the subgroups were pooled using a special technique described by Mantel.[13] The method has certain advantages compared with linear regression but it is difficult to use for more than three correlated × variables in a sample of this size. Multiple linear regression was therefore used in the last multivariate analysis. The correlation and regression coefficients were considered statistically significant for values of P <0·05.

Results
Obesity in relation to age
Table 1 shows the ranges and median values of WI in different age strata. There was a significant positive relation between age and WI (P <0·001).

Table 1   *Number of participants, participation rates, and ranges and median values of WI in relation to age*

Age (years)	Nos.	Rates (%)	Ranges	Median values
38	372	91·4	66–210	96
46	431	90·1	57–178	97
50	398	91·0	69–169	102
54	180	88·6	65–167	105
60	81	83·5	70–138	104
Total	1462	90·1	57–210	99

Socioeconomic status in relation to age
Table 2 shows the percentage distribution of the social class of the head of household in different age strata. There was a significant correlation between age and social class of the head of household (P =0·005). Social status declined with increasing age.

Table 2   *Percentage distribution of social class of the head of household in relation to age of subjects*

Age (years)	Social class of the head of household (%)				
	1	2	3	4	5
38	10·1	5·5	46·6	7·7	30·1
46	14·6	2·9	41·1	2·6	38·9
50	12·5	3·2	40·0	1·9	42·4
54	12·5	3·6	38·1	0·6	45·2
60	15·6	1·5	31·3	0·0	51·8
Total	12·7	3·7	41·4	3·4	32·9

Obesity in relation to marital status, age of husband, number of children, and housing standard
As shown in Table 3, there was a significant negative correlation between marital status and WI. Age of husband was significantly positively correlated with WI. There was also a significant positive correlation between number of children and WI. Type or size of housing were not correlated with WI.

Table 3   *Statistical significance of correlations between sociodemographic factors and WI*

Factor	WI given age direction	WI given age and social class direction
Marital status	− xx	− xxx
Number of children	+ xx	+ xx
Age of husband	NS	+ x
Housing (type)	NS	NS
Housing (size)	− xxx	NS
Education	− xxx	− xx
Own income	− xx	− x
Husband's income	− xxx	− xxx
Own social class	− xx	
Husband's social class	− xxx	
Sick leave	NS	NS
Pension	+ x	NS

NS = P >0·05
x   P <0·05
xx   P <0·01
xxx   P <0·001

Obesity in relation to education, annual income, and social class
Table 3 also shows that there was a significant negative correlation between educational level and WI. Own annual income and husband's annual income were both significantly negatively correlated with WI. There were also significant negative correlations between WI and both the woman's and her husband's social class.

Obesity in relation to sick leave and pension
Table 3 also shows the correlations between WI and sick pension and between WI and duration of sick leave during the year preceding the examination.

There was no significant correlation between sick leave and WI. There was, however, a significant correlation between WI and sick pension when allowance was made for age. The correlation was not significant when allowance was also made for social class.

Multivariate analysis
Thus age, social class, marital status, age of husband, educational level, husband's income, and number of children were significantly correlated with WI. A multiple linear regression analysis was performed to determine to what extent these contributed independently of each other. The results are shown in Table 4. Age, husband's social class, number of children, educational level, and husband's annual income were independent contributors to the variation in WI among the married women. In the single women age and own income contributed independently to the variation in WI.

Table 4 *Multiple linear regression analyses of the significant correlations between WI and some socioeconomic variables in the married women (n = 1064) and the single women (n = 309)*

Variable	Regression coefficient	Partial correlation coefficient	Significance of regression coefficient
MARRIED			
Age	+ 2·03	0·09	xx
Husband's social class	− 0·98	0·07	x
Education	− 0·75	0·07	x
Husband's income	− 0·10	0·10	xx
Number of children	+ 1·02	0·08	xx
Age of husband	+ 0·12	0·04	NS
SINGLE			
Age	+ 2·02	0·14	x
Own social class	− 1·00	0·07	NS
Education	− 0·26	0·02	NS
Own income	− 0·27	0·12	x
Number of children	+ 0·49	0·04	NS

NS = P >0·05
x   P <0·05
xx   P <0·01

Discussion
Population and methods
The representativeness of the sample was ensured by the method of sampling, the high participation rate, and the few differences between the participants and the non-participants. Among the latter there were somewhat more single women.[11] However, there were no differences in height or weight between the participants and the non-participants,[14] so no selection bias was introduced into the study regarding the correlation analyses between obesity and socioeconomic variables.

Weight index is highly correlated with body fat mass.[15] This index can be considered a valid measure of obesity in the present study.

The method used for the collection of socioeconomic data was mainly an interview. Some uncertainty about the validity of the self-reported data may be present. However, these methods have previously been used in epidemiological studies[11 16] and found to correlate well with corresponding data from official statistical reports.

Socioeconomic status as a measure of environment is of course inexact. However, it reflects the aspirations and opportunities of individuals in a family and also affects their values. Previous studies on this subject have included factors such as occupation, education, income, monthly rent, etc., and combinations of these, as criteria of socioeconomic status.[3–6 10 17] Education and income are probably the most important single factors determining socioeconomic status. In this study occupation only was used as a criterion of socioeconomic status. Because occupation is highly correlated with both education and income in modern society, and because the sample is large, no important error would have been introduced into the study by the fact that some individuals may have a high occupational position without having a high standard of education.

Comparison of our data with those in previous studies is difficult for several reasons. Different criteria are used for defining obesity and socioeconomic status, and there were sampling problems in most previous studies. What we have here is a large sample of middle-aged women randomly selected from the general population across the whole range of both obesity levels and socioeconomic status. Thus the results obtained are definitive for this Swedish urban population.

Relation between obesity and socioeconomic factors
The relationship between marital status and obesity found in the present study may be complex. A recent study of men found no relation between marital status and obesity level.[18] In earlier reports a positive relation has been found between obesity levels in husband and wife.[19 20] It is possible that obesity in itself has no specific effect on marital status and that psychological factors are important in explaining the relationship between obesity and marital status.

Pregnancy is often associated with changes in health norms and behaviour.[21] It is a common experience for women to become fatter with each pregnancy. Weight gained in pregnancy is often not entirely lost afterwards. A previous study on concordant twins showed a relation between many pregnancies and obesity[22] but this finding was not

noted in randomly selected women.[23] However, the present data accord with the concept that pregnancy might be a trigger for the development of obesity.

In a recent study of a highly selective sample of women, no relationship was found between obesity and own educational level.[7] Other studies of less selective samples have found a negative relationship between obesity and a woman's education which accords with our results.[10] Our study also confirms the previously reported association between low income and obesity in women.[7 10 24] These findings suggest that nutritional misinformation and income level both contribute to the development of obesity, probably by promoting the use of high-calory foods.

The present data confirm earlier reports showing an inverse association between social class and obesity in women.[3–6] Socioeconomic status has also been found to be associated with weight gain in women during their childbearing years, although to a small degree.[25] Recent studies indicate a declining difference in obesity levels between women in different social classes.[4 6 7] The differences found between a woman's obesity level, her social class, and that of her husband indicate that the social class of husbands is a much stronger determinant of obesity in women than their own.

The cause-and-effect relationships between obesity on the one hand and education, income, and social class on the other must be considered. The Swedish school authorities have never considered obesity to be a criterion for acceptance of a candidate. Obesity as such would thus not be a bar to attaining a higher education. Obesity is associated with a number of serious disorders[26] which may have a negative influence on income and occupation. However, the interrelationships between education, income, and occupation clearly indicate that obesity is the effect rather than the cause of low socioeconomic status. This point is further emphasised by the fact that no relationship was found between sick leave, sick pension, and level of obesity when social class was considered.

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